

example, the user equipment's use of the measurement gap may be minimized to a relatively rare occasion.

**[0036]** Although low priority carriers/RATs may be measured during non-gap measurement periods, higher priority carriers may be monitored/measured during measurement gaps and at any other times as well including for example during the inactive periods of DRX and IDLE mode.

**[0037]** In some example embodiments, user equipment cell identification and measurement requirements for low priority (or for example additional/new neighbor) carriers/RATs may also be defined to be more relaxed than the ones of the existing or higher priority neighbor carriers and RATs even in connected mode DRX or IDLE mode operations. This may enable minimizing the impacts on neighbor cell identification and measurements for the existing or higher priority neighbor carriers and RATs even in connected mode DRX and idle mode. In some example embodiments, this may cause the user equipment to take a longer amount of time to identify and measure a cell on lower priority carrier or RAT than to identify and measure a cell on the existing or higher priority carrier or RAT with the same DRX cycle and other assumptions.

**[0038]** In addition to the limitation of doing the lower priority (or additional new neighbor) carrier/RAT measurements at times other than the measurement gap time window (for example, as part of inactive portion of DRX after a drx-InactivityTimer has expired), the measurements may, in some example embodiments, be further categorized according to a DRX operation. For example, a lower priority carrier/RAT measurements may be performed in accordance with one or more of the following:

**[0039]** Lower priority measurement performed only when DRX is operated according to 'shortDRX-Cycle';

**[0040]** Lower priority measurement performed only when DRX is operated according to 'longDRX-Cycle';

**[0041]** Lower priority measurement performed when some time has passed since the DRX has started (e.g., additional timer for starting the measurements to increase the likelihood that user equipment will stay in DRX);

**[0042]** Lower priority measurement performed when an applied DRX cycle is exceeding a certain threshold (which may be used also to split into different lower priority classes); and/or

**[0043]** Lower priority measurement performed on one lower priority carrier once per on-duration/DRX cycle.

**[0044]** In some example embodiments, the network may also provide sufficient measurement time to the user equipment for the monitoring/measurements disclosed herein.

**[0045]** The following example embodiments relate to relaxed performance requirements that may be imposed on a user equipment when there is an increase in the quantity of carriers that a user equipment may need to monitor. Specifically, in some example embodiments, when the network configures a user equipment to monitor/measure more than 3 carriers, the user equipment may treat carriers beyond the 3 carriers as lower priority carriers on which relaxed requirements may be applied.

**[0046]** The network may indicate to a user equipment which carriers (or RATs) may be measured with a low priority and/or with relaxed requirements to enable a longer measurement period to complete the measurement or to enable a longer cell detection time. To illustrate, a user

equipment having relaxed requirements may not need to attempt identification (and/or search) and measurement of cells on lower priority carriers and RATs as frequently as identification and measurement is performed for higher priority carriers and RATs. Thus, relaxed requirements may relax the minimum time requirement (for example, by allowing more time) for a user equipment to identify a new cell on a lower priority carrier than the corresponding requirement for a higher priority (or existing carrier/RAT); and/or the relaxed requirements may allow more time for performing level measurements (for example, RSRP and RSRQ measurements) on lower priority carriers and RATs when compared to a higher priority or existing carrier/RAT. For example, when the network configures (or broadcasts to) information at a user equipment to enable monitoring of more than 3 carriers, any carriers beyond 3 carriers may be designated as lower priority carriers on which relaxed performance requirements may apply. Some user equipment, such as legacy user equipment, may only be able to handle monitoring 3 carriers, while other user equipment may be able to handle carriers in excess of 3. In the case of any carriers in excess 3 carriers, the user equipment may only be required to perform cell search and measurement according to relaxed requirements, such best efforts or as lower priority monitoring (for example, using non-measurement periods as noted above). To illustrate further, existing user equipment requirements defined in for example TS 36.133 may be applied if not more than 3 neighbor carriers are indicated to the user equipment, but if more than 3 carriers are indicated, another set of user equipment requirements may be used, so for example TS 36.133 may be extended to define the additional set of requirements. This additional set of relaxed requirements may most likely be defined so that more time is allowed for the user equipment to identify and measure cells on lower priority carriers(s) or carriers for which relaxed requirements are applied. This approach may ensure that the user equipment may not need to use limited measurement gaps for performing inter-frequency/RAT measurements. Moreover, a user equipment with 2 or more receivers may be able to identify the carriers in excess of 3 via application of relaxed requirements for cell search and measurement, and thereby benefit from lower priority/relaxed performance in terms of reduced power consumption for measurements. To illustrate, the relaxed requirements may impose best efforts for the measurements including measurements during idle periods (for example, during idle/inactive portions of DRX or during an IDLE mode). However, in the case of IDLE mode measurements (for example, measurements performed on the carriers/RATs in excess of 3), the network may not be able to configure additional measurements objects (for carrier frequencies) than what is already specified in the requirements for legacy user equipment (for example, user equipment in 3GPP REL8), so if the network adds more carrier frequency measurement objects, the network may not know which carrier frequencies the user equipment can actually measure. In the case of connected mode measurements, the network may need to get knowledge of which user equipment support of the carrier monitoring in excess of 3 features in order to know to which user equipment can be signaled to perform the increased amount of measurements objects.

**[0047]** In the case of IDLE mode measurements, the network may, as noted, not be able to configure additional measurements objects for carrier frequencies than what is